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TV PICTURE-TUBE VOLTAGE AND SIGNAL SYSTEMS*

In our analysis of the characteristics of high-voltage tv systems, last month, properties of picture tubes and their power requirements were discussed.

It was pointed out that a transient or flyback voltage supply is a part of the horizontal deflection output circuit and utilizes a transient voltage generated in the horizontal deflection coils to supply the high-voltage potential for the picture tube. A typical transient voltage-supply circuit was shown to illustrate this point.

Now, during the horizontal trace period a sawtooth of current builds up in the deflection coil and therefore a field is built up around the deflection coil. During the retrace period the deflection output tube is generally cut off, the rapid change in plate current causing the magnetic field to collapse and a high-amplitude single-alternation transient voltage to appear across the deflection coil. Were it not for the damping tube used in the secondary of the output transformer, this transient voltage would produce the series of damped oscillations, occurring at the resonant frequency of the deflection coil and the distributed circuit capacity. This one alternation, however, has a peak amplitude in the thousands of volts and can be used, if properly rectified, to develop a high d-c voltage.

The purpose of the horizontal sweep output transformer is to present the proper loading for the tube from the low impedance of the deflection coils. In so doing, the transformer turns ratio from primary to secondary is stepdown. This means that going from secondary to primary the transformer is actually stepup and the transient voltage developed in the secondary is further increased in amplitude by the stepup of the transformer and, consequently, the high-voltage pulse is still greater in amplitude in the primary of the output transformer. A higher boost in amplitude is also obtained by using an extended primary winding so there is a greater stepup between secondary and primary, the plate being tapped on at some point along the primary where the proper impedance match is made to the deflection coil.

The top of the primary winding is attached to the plate of a high-voltage rectifier tube which rectifies the transient voltage, which is now filtered to produce an essentially constant high-voltage d-c potential. It is important to note that the transient voltage itself is extremely short in duration and occurs during a portion of the horizontal retrace period. The actual spacing between pulses is relatively long and therefore if a d-c voltage is to be obtained the charge on the filter capacitor must be held during this interval. The actual frequency of any ripple voltage that might be apparent is the repetition rate of the horizontal sweep system, approximately 15,750, because one transient pulse is developed for every sweep period. It is apparent, therefore, that the ripple frequency is relatively high and rather small value capacitors can be used to do the filtering, a typical size being 500 mmfd. The time constant of the filter capacitors and resistor is sufficiently long to prevent any serious discharge of the filter capacitors during the interval between transient pulses. Fortunately, it is no difficult task to do this because the actual current required from the voltage source is extremely small and therefore the resistive component of the discharge circuit extremely high. Actually the second filter capacitor of the high voltage system is the capacity that ex-

**By Edward M. Noll in "Service," from a forthcoming book, "Television for Radiomen," to be published by Macmillan.*

ists between the second anode coating on the inside of the picture tube and the grounded outside coating which is external to the glass of the picture tube, the glass serving as a

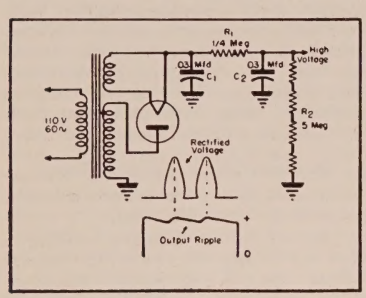


Fig. 1. Transformer high-voltage supply.

dielectric. The effective capacity between coatings is approximately 500 mmfd. A considerable charge can be retained on this capacity and although it is not dangerous it is often surprising and causes one to drop and injure the picture tube. It is wise to always ground the second anode momentarily to the outside coating before picking up the tube.

The heater potential for the high-voltage rectifier is obtained by means of a small few turn pickup coil which is also wound on the core of the horizontal output transformer. The energy inducted into the winding by the fast changing magnetic fields is sufficient to excite the heater of the high-voltage rectifier tube. The pick-up loop is, of course, properly insulated for high-tension voltages.

Transformer Type High-Voltage Supplies

Two transformer supplies excited by 60-cycle power mains are shown in Figs. 1 and 2. If any amount of current were necessary at the extremely high voltages required the transformer would be massive. Fortunately, only a small current is necessary and although it is a high-voltage transformer, it need not be excessively bulky. Consequently, the windings are constructed of small diameter wire and if, for any reason, a partial short is placed across the transformer, the windings open up. Many receivers use a safety resistor to limit the current, such as resistor R_1 in Fig. 2, which prevents excessive secondary current in case of a partial or complete short across the high-voltage output of the power supply. One must be extremely cautious when working on the high voltage supply excited by the 60-cycle power mains because the current capabilities of such a system are very high. And, in addition, an appreciable charge is stored in the filter capacitors because they must be of a large capacity to effectively filter the low frequency, 120 or 60-cycle ripple frequency.

The simple high-voltage supply shown in Fig. 1 consists of a half-wave rectifier and a simple R-C filter. When so little current is drawn from the supply half-way rectification and simple filtering is all that is necessary to remove the ripple frequency. Actually the ripple component looks similar to a sawtooth wave as shown in Fig. 1, because capacitors C_1 and C_2 charge when the rectifier conducts and discharge when the rectifier is non-conducting or doing the opposite alternation of the applied 60-cycle sine wave. Every attempt is made

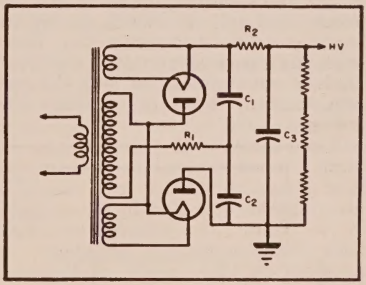


Fig. 2. A transformer high-voltage supply using a voltage doubler setup.

to keep this ripple under one per cent of the d-c output voltage by properly choosing a long-time constant R C filter which does not permit the capacitor to discharge appreciably during

the non-conducting alternation of the rectifier, in accordance with the current required. The time constant of the R C filter must be high in comparison to the period of the wave which it must filter. Of course, a given time constant can be formed with a large R and a small C, or a large C and a small R.

The choice of R and C depends on the current required and the regulation expected. For example, if the current requirements are extremely light the R of the time constant circuit is very large and for a given time constant a relatively small value of C is required. If the current requirements are higher or if better regulation is desired with a change in the brightness adjustment, a heavier load must be placed on the high-voltage power supply. This is accomplished by reducing the value of the bleeder resistor or the R of the time constant. In this arrangement, of course, a larger C must be used to produce an equivalent time constant, and the current capabilities of the entire system must be somewhat higher.

The power supply filter of Fig. 1 is called a double-section filter because of the addition of an input capacitor, C_1, and a series resistor R_1. In this filter system the initial peak charge is placed on C_1 and the discharge voltage which is mainly developed across R_2 is also filtered by capacitor C_2. Consequently the proper amount of ripple filtering can be obtained with the use of component parts of smaller value and size. The system of Fig. 2 uses a voltage doubler output method in which capacitors C_1 and C_2 are charged on opposite alternations of the input sine wave. Consequently, in this circuit, the ripple frequency is 120 cycles and the components of the R C filter can be made smaller in value. Thus it is ideal when very high potentials are desired and an extremely high voltage can be obtained which is double the sine wave peak output of the secondary of the transformer.

Oscillator High Voltage Supply

Another safe and practical means of generating the high voltage required for picture-tube operation is the use of a low-frequency oscillator and the voltage stepup characteristics of a tuned transformer. Such a basic oscillator high-voltage supply is shown in Fig. 3. In this type of supply a beam power tube or a power pentode is used to generate strong oscillations. For best stability and a constant output over a substantial range in frequencies a feed-back system using a tickler winding is used as the oscillating method.

The resonant frequency of the oscillation is set by the primary of the transformer and feedback to the grid is through the tickler winding, grid bias being developed by the grid current flow through R_g and sustained by capacitor C_g. The primary and secondary windings are generally overcoupled to obtain a broad bandwidth and in case of frequency drift due to heating or change in supply voltages, the output will remain essentially con-

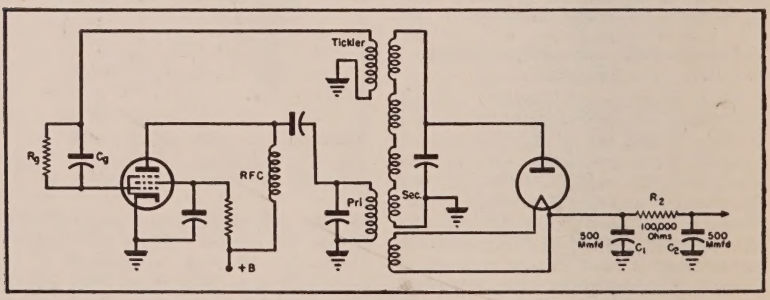


Fig. 3. An oscillator high-voltage supply system.

stant in spite of the frequency change. A high-voltage half-wave rectifier is placed across the secondary of the transformer and rectifies the resonant voltage developed across the secondary. Again a simple R C filter is used to remove the ripple frequency. The oscillators are designed to operate generally in the range somewhere between 50 and 300 kc. Consequently, with the relatively high frequency used, very little filtering is required. The oscillating high-voltage supply is again a very safe high-voltage system because of the small size of the filter capacitors and the fact that any load placed on the output of the high voltage will cause the oscillator to stop operating or decrease the output voltage to a safe value.

To obtain a substantial voltage amplification in the tuned transformer it is necessary that the secondary be lightly loaded and therefore have a high impedance as compared to the impedance of the primary winding. Fortunately, the television picture tube again draws only a very small current and does not contribute an appreciable load to the secondary of the tuned transformer. Other factors which insure a high voltage across the secondary is the proper choice of winding for the transformer and the proper choice of wire. In many of these high-voltage oscillating transformers Litz wire is used because of its inherent low resistance and substantial inductance. Consequently, it is possible to construct a winding which has an extremely high inductance by using many turns of wire and at the same time the resistance and consequent power loss will be low, if the wire used has a very low resistance. Of course, the smaller the wire the closer it can be wound and again the more inductance the winding will have. It is evident, therefore, that Litz wire is ideal because of its small diameter, high inductance, and low resistance. Inasmuch as the impedance of the secondary varies as the square root of the inductance over the capacitance, every attempt is made to keep the distributed capacity at a minimum and the inductance high. Therefore, the secondary is resonant to the proper frequency with the distributed circuit capacity and no physical capacitor is shunted across the secondary. In addition, rectifier tube and component parts chosen must have a minimum of capacity. Again, as with the transient voltage supply the heater potential for the high-voltage rectifier is obtained from a small winding mounted on the transformer.

The secondary winding of the transformer is generally a pie-winding of five to six pies and in some cases, even the primary is constructed in a pie-winding arrangement. The layout of a typical pie-wound coil is shown in Fig. 4. The secondary is made up

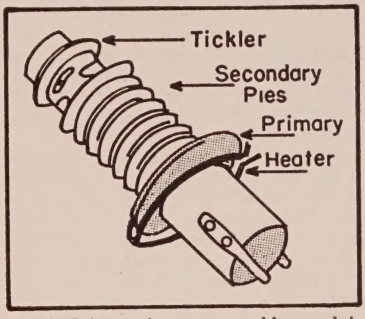


Fig. 4. R-f transformer assembly used in high-voltage tv power supply systems.

of a series of five pie-windings, each pie-winding universally wound with 5 to 10 turns per layer. The separation between pies is generally a little greater than the pie width. Too great a pie width increases the distributed capacity and too narrow a pie width reduces the mechanical stability of the winding structure.

To analyze the advantages of a pie-wound secondary, let us assume a pie-wound secondary consisting of five pies and having a total output voltage of 5,000. This means that the voltage developed across each pie will be 1/5 of 5,000 or 1,000 volts. Consequently, each pie can be designed for a 1,000 volts difference of potential. If the entire secondary was universally

wound, or layer upon layer, the latter turns of the winding would be reasonably close to the beginning turns and consequently would have to be designed for a breakdown potential of

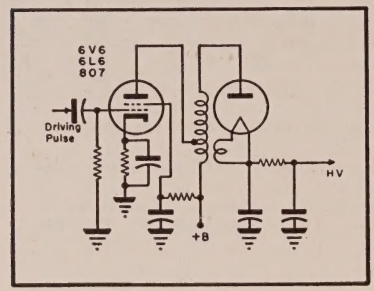


Fig. 5. Pulsed high-voltage supply system.

5,000 volts. Inasmuch as the start and finish of the pie-wound secondary are very well separated only the breakdown of the individual pie must be considered.

Likewise, the distributed capacity is not felt between the early windings of the secondary and the final windings, but again just between the windings of the individual pies, the distributed capacity of each pie adding in series causing a lower distributed capacity to exist between the start of the secondary winding and its termination.

Another system for generating a high transient voltage which can be rectified and used as a high voltage d-c potential is the pulse type high-voltage supply shown in Fig. 5. In this supply the grid of the pulse amplifier is driven by a short positive pulse such as might be obtained from the grid of a block tube oscillator. This sharp pulse drives the pulse amplifier to saturation causing a sharp change in plate current which develops a high voltage transient in the inductor and is stepped up to a high peak voltage by the auto-transformer connection. The top of the winding is again connected to a high-voltage rectifier which obtains its low-current heater voltage from the same auto-transformer by mutual coupling. A simple R C filter is used in the output circuit.

An ingenious high voltage supply is that associated with the beam-relaxor horizontal-scanning generator developed by Farnsworth. In this circuit, Fig. 6, no sawtooth oscillator is required, the deflection amplifier functioning itself as an oscillator. The beam relaxor oscillator develops a short positive pulse in the plate circuit, which is stepped up in amplitude by the auto-transformer arrangement of the secondary and supplied to the plate of a high voltage rectifier. A simple R C filter is used to remove ripple.

In summation there are a number of methods which can be used to generate a high-voltage low-current source, and although the d-c potential is in the thousands of volts these supplies are relatively safe with the exception of the transformer type driven by excitation from the 60-cycle line.

However, the trend is away from the transformer type toward the safety of the transient voltage and oscillating voltage supply. All of these higher frequency high-voltage systems are practical and efficient, but must be well shielded to prevent interaction with other circuits associated with the television receiver. Fortunately, some

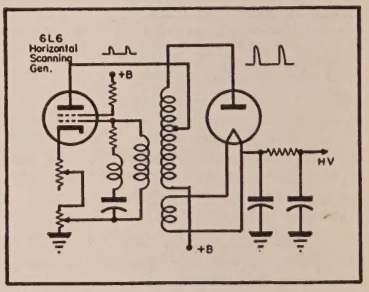
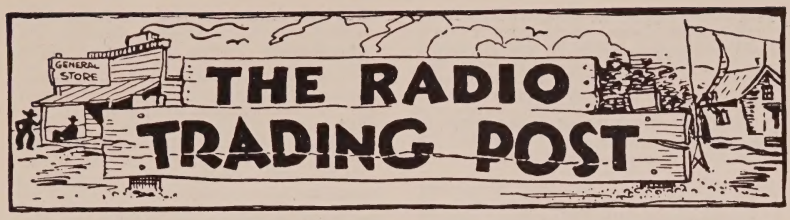


Fig. 6. A beam-relaxor type of circuit developed by Farnsworth.

interaction can be tolerated because the generation of the high-voltage pulse is during the retrace of the horizontal sawtooth, when the picture beam is cut off.



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TRADE—Stancor P-20 xmitter, cw and phone, complete with crystal, coils, mike, and Vibroplex "bug" key. Want Sparx or Feiler sig. tracer in good condition. Sam Torrisi, 57 Mechanic St. Lawrence, Mass.

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FOR SALE—Old model tube tester "Unimeter" good condition. Will sell for $17 or swap for multimeter. Donald C. O'Niel, Dept. 59-C, 5034 Attleboro St., Jacksonville 5, Florida.

FOR SALE—Ex-GI selling out radio shop. New test equip. and new Riders manuals, plus stock. All for $570. Send for list. All replies answered. Frank Ahearn, 2901 Wasp Rd., Camden, N. J.

FOR SALE—Wired Heathkit amplifier, $12.50; Tel-ohmike TO-3 condenser tester, $50; grab bag of 70 tubes, (list $100-200), $20; Hallicrafter S-38, $42. Want Webster wire recorder. C. A. Winans, Morris, Ill.

SALE OR TRADE—Gardiner Sender; Bud oscillator; portable radio; Kleig lights. Want Meck 60N, Hallicrafter-HT6, etc. G. Samkofsky, 527 Bedford Ave., Brooklyn 11, N. Y.

FOR SALE—Brand new comb. Weston analyzer and tube checker, model 778, $80. Also complete set of Radio Technical books (no Riders). Very reasonable, all new. Sid Levine, 764 Lafayette Ave., Brooklyn 21, N. Y.

WANTED—Test Instruments: sig. gen., VTVM, sig. tracer, oscilloscope, etc. State make, model No., condition, and price in first letter. A. F. Newman, 61-25 Parsons Blvd., Flushing, L. I.

FOR SALE—Supreme Vedolyaer, perfect condition, $150. Also 90 and 1½V farm battery eliminators, $9. Want to hear from those that have studied the course in Psychiana. Frederick R. Shutt, Box 144, Mullens, West Virginia.

POSITION WANTED—Have some experience repairing radios, tools, equip., etc. Prefer Tri-State area of Iowa, Minn., and Wis. Also have a Philco 6V input self rectifying vibrapack I wish to sell. Gerald R. Kernan, Harpers Ferry, Iowa.

FOR SALE—Transvision 7" television rec. with 3 stage booster and workshop TV 63 aerial and all diagrams. Fine picture. Wired and tested, $150. Paul Leese, 706 W. Vine St., Lancaster, Pa.

FOR SALE—Radio parts: Voltmeter, miliammeter, filament transformer, rheostat, industrial VOM, etc. Jim S. Berry, Summerville, Georgia.

SELL OR SWAP—Books and comic magazines for a radio correspondence course and radio books on the servicing end. Also need test equip. and parts. Min Takamoto, 420 Pearl St., Monterey, Calif.

FOR SALE—2 tube phono oscillators, $2.75. 12 SA7 and 35Z5 kit for oscillator, $1.15. "Phonograph Kit:" 3 tube amplifier with tubes, motor, 5" PM speaker with trans., crystal pickup, all for $9.75. Portable case for above, $3.75 money order. V. Wiener 157 E. 49th St., Brooklyn 3, N. Y.

SWAP—Phoenix recorder, new single speed (78), play back, PA, mike. Trade for late sig. shifter or what have you? Felix Januss, 813½ Francisco St., Los Angeles 14, Calif.

FOR SALE—Radio shop complete with stock of tubes and parts. All testers are practically new. Write for details. Roman's Radio Shop, Wellsville, Mo.

SALE OR TRADE—Have National NC-44 communication rec., and Hammarlund Comet Pro SW rec. Also Riders manuals. Want Hallicrafters S29 Sky Rover, Precision tube tester. Will exchange lists. Glenn Watt, Chanute, Kansas.

FOR SALE—Spring wound phonograph motors and parts, Victor Columbia, and others. Plans for electrifying them with 6V auto fan motors or any other small low voltage motor given free. George Messig, 742 McDonald Ave., Brooklyn, N. Y.

FOR SALE—V-O-Milliammeter; condenser checker; sig. gen.; tube tester; condensers; resistors; tubes, 155, 1T4, 1R5, 3S4. Will trade for TV set. Raymond Julian, 337 So. 3rd St., Steelton, Pa.

FOR SALE—Equipment and stock of radio repair shop. Riders manuals, tube tester, sig. gen. tubes, parts, etc., $550. Write for complete list. all letters answered. The Radio Clinic, Angola, Indiana.

FOR SALE—Model 170 RCA Audio Chanalyist in good operating condition. Will accept best reasonable cash offer. Complete with all accessories and instruction book. Robert C. Chrouch, 206 E. Main St., Lowell, Mich.

FOR SALE—Send for list of radio and photo equipment and supplies, below retail. Lund, Box 948, GPO, New York 1, N. Y.

FOR SALE—Precision tube and set tester 654P; Jackson oscillator 640; Electronic voltmeter ohmmeter 29; Solar capacitor analyzer CE 1-60; Supreme manuals. Instruments in perfect condition, subject to your inspection. Joseph Truce, Aurora, Ohio.

FOR SALE—Home constructed combination test instrument. Sig. gen. covering BC and IF bands, condenser checker and 6E5 tuning indicator in steel cabinet. Power supply voltages avaiable at front panel jacks. Jim Gaston, 57 Tuxedo Rd., Montclair, N. J.

FOR SALE—Brand new Philco tubes in indiv. cartons. 60% off reg. list price. 50L6GT, 7A8, 25L6GT, 125A7GT, 35W4, 35Z5GT, 25Z6GT. Limited quantity, first come first serve. S. Winterfeld, 1326 Wheeler Ave., Box 59, New York City.

SWAP—"Proceedings of the I.R.E." January, 1946 to June, 1948, for U.S. or foreign stamp collection. B. Bernbaum, 5746 N. Park Ave., Philadelphia 41, Pa.

FOR SALE—Complete stock of radio shop including tubes, condensers, resistors, Riders, and misc. parts and supplies. Let me know your needs. Price is right for all or part. Meyer Kaufman, 431 10th Ave., Paterson 4, N. J.

FOR SALE—RCA tubes. 1-8012-A $6; 3-2X21879 70c; 10-bac 7/1852, 90c ea. 1 Eicor dynamotor, input 27V DC 6.05A; output 300V DC 200A 18V AC 2.2A. John Hannahs, 5913 Capulina Ave., Morton Grove, Ill.

FOR SALE—RCA 3" oscilloscope with spare tube; Hickok 188X sig. gen.; CTC hermetically sealed xformers and chokes; new lots of tubes and other parts. Make offers and send for list. Nelson K. Stover, PO Box 722, York, Pa.

FOR SALE—Superior sig. gen. 1230, $15; 5" scope, $25; 813, $4; 5BP1, $2.50; BC375 and BC610 tuning units cheap; homemade handy talkies, $7.50 pr. Frank H. Carlson, New London, Iowa.

WANTED—Latest model sig. gen.; wire recorder, with wire; amplifier, portable preferred. E. R. Peltier, CB&Q Telegraph Office, McCook, Neb.

FOR SALE—Scott marine radio, 11 tubes, 3-18 mcs. BC 223AX, tubes, manual, tuning units, mike, no power supply, for 75 or 80 meter phone or cw. Make offers. Need code oscillator. Donald DeVoe, 120 Godwin Ave., Ridgewood, N. J.

FOR SALE—BC224 communications rec., a fine unit for ham or amateur covering exactly the same band and with precisely the same circuit as the BC348. The only difference is this works from 12V DC. $50 less dynamotor. David T. Armstrong, 221 Angelique St., Weehawken, N. J.

FOR SALE—Riders Manuals, Vols. 4 to 13 inclusive, $89. Cloyd's Radio Shop, 454 So. 3rd St., Hamilton, Ohio.

WANTED—Set of Antenna, two R.F. and oscillator (456kc) coils for 6, 10, 11, 20 and 40 meter ham bands. Give full particulars. T/4 William C. Schaefer, Signal Corps Photographic Center, 35-11 35 Ave., Long Island City, New York.

FOR SALE—Record player with automatic changer and 4 tube amp., $37.50; Motorola auto radio $20; Webster Chicago 76 changer, automatic shut off after last record $22.50; Precision 912 tube tester, $55; Jackson 640 sig. gen., also new, $45. Jack Pirkle, Oakland City, Indiana.

WANTED—Power transformer in good condition for Sparton AC Rec., model 931, Serial 13779. Bob's Radio Service, 400 Potter, Lansing 10, Mich.

SELL OR TRADE—Camera, enlarger and photo equip. Want a television set or kit with at least 7" tube. Write for list. Will answer all letters. Joseph Sarnese, 532 N. 53rd St., Philadelphia 31, Pa.

FOR SALE—Electric portable phono player, plays 10" - 12" records, 3 tube amplifier, leatherette carrying case, $19.95. Shipped COD we pay postage. Messenger Radio Lab., 16 Rockhill St., Foxboro, Mass.

FOR SALE—One Philco Junior Scope, new. Also 1-50 0 50 DC MA; 1-150 0 150 DC Micro Am.; 1-0 1 DC MA. Stellas Music Shop, 583 East 138 St., Bronx 54, N. Y.

FOR SALE—Radio Engineering Handbook, by Henney, $2.50 COD; Practical Radio Communication, by Nilson and Hornung, $2.50 COD. Paul H. Prokes, 9216 S. Menard Ave., Oaklawn, Ill.

FOR SALE—3 General radio variacs 5 amp size, all for $30. Also 1,500V, 400 MA power supply on relay rack chassis and panel, complete, $40. B. N. Gensler, 573 Chester St., Brooklyn 12, N. Y.

FOR SALE—6 tube Fada model 637 portable de luxe radio-phono with automatic changer. Slightly used in excellent condition, $50. C. J. Varanay, 3396 W. 52 St., Cleveland 2, Ohio.

FOR SALE—Superior sig. tracer, CA-11, $13; Drake 100W soldering iron, $3. Also books. Send for list. Every card answered. William J. O'Malley, 2801 Versailles Ave., McKeesport, Pa.

FOR SALE—Hammarlund SP-400-X in perfect shape. First $250 cash. Has Bliley 100kc crystal frequency marker unit. Radio Communication Service, 4475 Myrtle St., San Diego 5, Calif.

FOR SALE—30W amplifier, 12" PM speaker and hand dynamic mike, $50; Electric megaphone type TPM-4 complete, $25. John Arnold, P.O.B. 84, Bluffs, Ill.

FOR SALE—Slightly used RME84 rec., $75; code practice oscillator, $10; bug, $6; 2 ohm sounder, $5; hand key and phones, $1.Write John Bisbee, 85-18 104th St., Richmond Hill, L. I., N. Y.

SELL OR SWAP—Post war Hallicrafters S-20-R rec. in perfect condition except for voice coil. Will sell or trade for good reflex camera. B. Abrams, 1828 Longfellow Ave., New York 60, N. Y.

FOR SALE—Oscillatone, with 15 tapes for sending and receiving Morse code. Bat. or elec. What have you? S. Mellon, 3103 W. Berks St., Philadelphia 21, Pa.

FOR SALE—Power supply, complete ready to go—2,000V, 300MA. J. W. Chambers, 8011 Vicksburgan, Los Angeles 45, Calif.

SWAP—Complete radio and television workshop will exchange for equivalent in woodwork, metal, or print shop, or what have you? C. Bufano, 185 No. 15th St., Bloomfield, N. J.

FOR SALE OR TRADE—RCA 1632 tubes, 50c each, or will trade for popular types. F. Lewis, 548 Brompton, Chicago 13, Ill.

FOR SALE—Ghirardi's Radio Trouble-shooter's Handbook, $4; also Ghirardi's Modern Radio Servicing, new, $4. Shipped post free. Adar Nissan Associates, 400 E. Tremont Ave., New York 57, N. Y.

TRADE—Radio parts or cash for pistols and revolvers, no antiques or shop-made guns. Also .22 r.f. and .32 c.f. cartridges. Also have printed items to order, calendars, jobbers goods, etc. Eddie Howell, Gen. Del., Gastonia, N. C.

FOR SALE—Rider's Manuals, complete, volumes 1 to 14 inclusive, in good condition, $125. Will ship upon receipt of $25. Balance COD plus express or parcel post charges. James Nash, 26 Cherry St., Waterbury 6, Conn.

FOR SALE—3" oscillograph, Clough-Brengle type CRA, 1st class condition, new CRT, $70. Also Exakt IIIA enlarger, 2 Cassar lenses f 4.5, 2¾" x 3¾", 1A condition, $75. Herman D. Wieck, 2213 Payne St., Louisville 6, Ky.

WANTED—Television set or chassis, in either new or used condition. H. Latko, 1922 Dickens, Chicago, Ill.

FOR SALE—Cine Kodak Special, moving picture camera, with turret head and two lenses. With lamp for sound, a $1,100 value. What cash have you to offer? Examination invited by interested parties. Russell,, 4 Elmhurst Road, Highland Park, Camp Hill, Pa.

FOR SALE—Belgian Browning 9mm automatic pistol, $35. Assorted lot 16mm empty film reels from 25' to 400'; 2 400' storage cans; 1 16mm splicer. Make offer. Rutherford Radio and Elec., Rosiclare, Ill.

WANTED—1 set of coils for 10 meter and also for B. C. band, for a National FB7 rec. State price. Seaman's Radio Service, 215 Stadium Drive, Findlay, Ohio.

FOR SALE—Simpson model 315 sig. gen. Used approximately 6 hours. $50 FOB. J. B. Fell, 517 Avenue G, Billings, Mont.

FOR SALE—New tubes—2C22, 10Y, 6C4, or 12A6 at 25c; 829B, 832A, or 5CP1A at $2.50 each; 6Y6G, 6AC7, 6SN7 at 40c each; 1,000 WVDC, 25mfd cond., $2; 330 VAC, 9 mfd. at $1. W. G. James, 135 E. Vance Rd. Oak Ridge, Tenn.

WANTED—Model 56 or 156-27 Webster changer. State price wanted. Joseph Grisafi, 45-16 49th St., Woodside L.I. 4, N. Y.

FOR SALE—Marlin 81DL .22 cal. rifle, like new with 4x Weaver G4 scope, adjustable peep sights and sling. Rifle holds 25 shorts or 18 long high velocity shells. $35. Harry Brown, 412 West Vine, Knoxville, Tenn.

FOR SALE—7" Electro-Tek television set, complete with tubes and cabinet. Set aligned on 3 NY channels, $100. Samuel Semel, 111-55 77 Ave., Forest Hills, N. Y.

FOR SALE—.22 cal Winchester repeating rifle, W.R.F.—take down, with case and cartridges, $20. Or exchange for late model tube tester. Also want small 110V AC motor. Horace W. Leeds, 15 West 15th St., Ocean City, N. J.

WANTED—Supreme Manuals. State price and condition. Also, have 8mm movie film for sale or trade for radio parts. Min Takamoto, 420 Pearl St., Monterey, Calif.

FOR SALE—Complete 2 meter station. Xmitter xtal controlled with 4 tube "832-A" final. Rec., 9 tube super het., slug tuned, modulator, mike. All in excellent condition ready to go. No reasonable offer rejected. Mike Wilson's Radio Serv., Toledo, Ill.

FOR SALE—Rabin rotary 110V DC converter, 275 amp., 3,600 rpm, with filters. Sell to higest bidder FOB. Condition like new. H. Roth, 1381 Sterling Place, Brooklyn 13, N. Y.

FOR SALE—MacQuire two post automatic record player, complete with walnut case, 3 tube amplifier and 4" speaker. First $30 takes it. David W. Schieb, Box 213, Valley View, Pa.

TRADE—8 x 30 new Jap binoculars, with case. Want tube tester, or AC operated sig. gen. J. Greener, 195-07 37 Ave., Flushing, N. Y.

WANTED—One or two 12B8GT tubes. Exchange or cash. Odessa Radio Shop, Odessa, N. Y.

FOR SALE—Model "900" Vomax; Meissner oscillator coil and set of plastic IF coils; two new Federal 100 MA rectifiers; phono oscillator; 35 new tubes in orig. cartons. Write for complete information. R. G. Watkins, Cliffside, N. C.

FOR SALE—G. E. tube checker, model TC-3, portable unit. Revised tube chart for latest type tubes available. How much am I offered? Max M. Finkelstein, 1711 Ocean Parkway, Brooklyn 23, N. Y.

FOR SALE—Jackson model 523 oscillograph with operating instructions. Best offer. A. J. Catalano, 2230 So. 10 St., Omaha 8, Nebr.

WANTED TO BUY—Philco 077 signal generator, and Philco 044 audio signal generator. Andrew J. Selzer, 60 - 17th Ave., Newark 3, N. J.

FOR SALE—Weston tube checker, model 777, almost new. First $45 takes it. C. Wollman, 90 Bank St., Valley Stream, N. Y.

WANTED—6V 10-14 amp auto radio, DC power pack (preferably copper oxide or selenium rectifier). Will pay cash or trade for Superior CA-11 sig. tracer and books. Better Radio Service, 1601 Williams St., McKeesport, Pa.

FOR SALE—Radiomen: Use my 100,000 name mailing list to sell your items. For full particulars write to, Gerald Samkofsky, 527 Bedford Ave., Brooklyn 11, N. Y.

FOR SALE—Complete De Forest's Training Course with questions and answers, $45. Also 15 new electronics books covering all receiving and transmitting subjects, $30. Postage paid. A. C. Henninger, 49 Congress Ave., Providence 7, R. I.

FOR SALE—Power pack for Majestic model 90—No. 9P6 power pack. Perfect condition, $7.50. Joe Holt, Box 293, Clinton, Ark.

FOR SALE—Like new RCA 155C 3" oscilloscope in orig. carton, $80; push pull 807 modulator with UTC PA transformers 120 watts output, with tubes and power supply, $45; new Seeburg record changer, $12.50; Custom FM tuner; and other small parts. John Urban, 140-34 Holly Ave., Flushing, N. Y.

FOR SALE—National Schools complete course on radio, television, sound and electronics, $20. Over 100 lessons. Parcel post collect. Lloyd L. Melton, Norwalk State Hospital, Norwalk, California.

SELL OR SWAP—One fine watch, ladies Helbros, 17 jewels, solid 14kt rose gold case, No. 32744R, new, in factory box, cost $65. Swap for radio equip., 35mm camera, or what have you? Raymond H. Ives, Route 1, Lake Terrace, Norfolk, Va.

FOR SALE—Selling out—tubes, parts, etc., at 50% off list. Have complete line, all standard makes. Electric timer clocks, $5.95. Will ship COD. Shingler Radio Service, Box 576, Graceville, Florida.

SWAP—Minicam Photography magazine, March '46—May '48, excellent condition, for CQ, March '45—May '47, or what have you? Arthur Larkey, 223 West Summit St., Somerville, N. J.

TRADE—NC101X, 1,600V at 300 MA power supply; 100W CW transmitter; binoculars; old wood prints; old classical records. Want test equip. or violin. Percy Ott, 507 Juniper St., Quakertown, Pa.

TRADE—De Forest training course in radio, radio servicing and television. Want hand printing press 5x8 or larger, or Rider's Manuals 12, 13, and 14, Cookson, Lock Box O, Puxico, Mo.

FOR SALE—Garrard English 2 speed phono motor; Weston micro-ampmeter, bakelite case; Weston precision wire wound resistors; crystal spek. J. R. Holloway, Box 133, Haddonfield, N. J.

TRADE—One Weston meter, model 506, microamperes 0-500 micro-am. DC. Want meter of similar polarity (0-1 or 0-10 milliameter) of which I would pay the difference, if reasonable, for the latter. John N. McDonald, 63 Gilmour Ave., Toronto 9, Ont., Canada.

FOR SALE—Rider's NRI Service Manual Vol. I, very excellent condition, $12 cash. Ervin Casper, 13703 Syracuse St., Detroit 12, Mich.

WANTED—Complete bulkhead speaker with cable and plug for a Motorola model 70 auto radio. All letters answered. Paul Capito, 637 W. 21 St., Erie, Pa.

FOR SALE—Precision E-200 sig. gen., used very little, like new, $48. All letters answered. Martin Mayerick, 140 Sunset Ave., Verona, N. J.

FOR SALE—120 lesson De Forest training course with questions and answers. Best offer. Gregory H. Swiska, 109 E. School St., Woonsocket, R. I.

FOR SALE—Riders Manuals, Nos. 1- 2- 3 for $5 each, No. 6 for $7, Nos. 7, 8, 10, 11, 12 for $10 each. Also Supreme most needed radio diagrams, volume 1 to 5 inclusive at $1 each. All books in very good condition, FOB Phila. George Keefe, 4937 Chancellor St., Phila. 39, Pa.

FOR SALE—One Hichock model 955 volt-ohm-mill. Used very little and in A-1 condition. $25. B. T. Brake, Jr., RFD No. 2, Eatonton, Ga.

TRADE—Voightlander Avus 9x12cm camera, f4.5 lens, double ext. bellows, complete with Kalart Master speed flash. Want good sig. gen. Also have RME 45 with speaker and Hallicrafters S40A rec. for sale. Emil A. Gacek, 23 Shumway St., Buffalo 6, N. Y.

FOR SALE—Jackson model No. 637 portable dynamic output tube tester and multi-meter. In fine wood cabinet with leads and instructions, $75. John P. Shulnes, Jr., 923 Timberland Ave., Pittsburgh 26, Pa.

FOR SALE—Recordplayer, noiseless, 100-120V 60 cycle, lightweight pickup, perm. needle, excellent freq. response, 12x10x 4", slightly used, $6 A. Russo, 160 Sherman Ave., New York 34, N. Y.

FOR SALE—10x50 German binoculars, 2 German bayonets, nazi flag, G.I. can openers 10c each. George Lukes, 1321 So. Highland Ave., Berwyn, Ill.

FOR SALE—New stenotype machine, with lesson and reading material, $55 Albert E. Golem, 233½ W. Utica, Buffalo 9, N. Y.

FOR SALE—EICO model 221 vacuum tube volt meter. Measures up to 1,000 meg-ohms-1,000V AC or DC. Brand new in orig. carton, complete, $33. Johnson's Radio Sales and Service, 30 Centre St., Tamaqua, Pa.

SELL OR TRADE—Sig. gen., oscillator tube, rectifier and neon tube audio oscillator. Audio output tap. Guaranteed broadcast and IF service instrument. J. Lewis, PO Box 686 Journal Square Station, Jersey City, N. J.

SELL AND TRADE—Party records, 25 different $1.05 each, send for list. Want old RCA Victor Horn Type phonograph in repairable condition. Also 16mm projector, films, or what have you? Akerberg's, Box 6, Stanley, N. Dak.

FOR SALE—Temco 500-GA 500W output on phone and 750 on CW. Freq. range 3.5-7-14-21-28mc. Cost $1,800, sell for $1,300. Also National 1-10-A complete for $70. William S. Johnson, 521 8th St., Ocean City, N. J.

FOR SALE—Guitar amplifier complete with tubes and 7½" speaker. All mounted in speaker baffle 12x14x5½" finished in 2 tone oak and walnut, $16. Also Howard Sam Photo Facts, No. 1 to 11, will swap for Rider's Manuals up to No. 8. John DiMonte, 142 Spencer Ave., Chelsea 50, Mass.

FOR SALE—NRI Radio demonstration course, complete with all parts, manuals, NRI tester (without batteries), and AC power pack, $20. Postage prepaid in U.S.A. Alfred Zunker, Jr., Needville, Texas.

WANTED—Two "Handie-Talkies" complete with or without batteries. Slim's Radio Shop, Fallon, Nevada.

SELL OR TRADE—9,000 copies "Our Bill Of Rights," 8x11", printed in two colors, $5 per thousand. Or trade for sig. gen. or anything useful in radio servicing. F. Silverman, 7558 Parkdale Ave., Clayton 5, Mo.

FOR SALE—Sonar XE 10 exciter with 6 crystals and 0-1 milammeter. make offer. P. J. Faulkner, 136-05 Sanford Ave., Flushing, N. Y.

FOR SALE—Complete radio service equip. Instruments, parts, tubes and manuals at bargain prices. Send for complete list. E. F. Korstick, 609 N. Shabbona St., Streator, Ill.

FOR SALE—One Hammarlund "Super-Pro" rec., model SP-400-X, new and in perfect condition with Jensen 12" PM speaker in matched metal finish cabinet. B. A. Neal 83 N. Main St., Mansfield, Pa.

FOR SALE OR TRADE—One model C. E. Solar Capacitor Analyzer; one model No. 153 RCA all-wave sig. gen.; one model No. BF50 Cornell Dubilier Capacitor Analyzer. Want SX-42 Hallicrafters Radio, or what have you? D. L. Smith, PO Box 191, Leaksville, N. C.

FOR SALE—Hallicrafters SX-28 and enclosed speaker, in perfect condition. Make an offer. Joseph L. Mancuso, 322-26 Ellicott St., Batavia, N. Y.

FOR SALE—BC-348 rec. with speaker and 110V AC power supply, $50. George Drab, Jr., RFD No. 1, Fort Plain, N. Y.

TRADE—RCP multimeter; GE tube tester; Philco dynamic tester; television kit assembled less C.R. tube; manuals; all O. K. Want Accordian, Solovox or Vibraharp. G. Thoden, RD 1, Box 117E, Asbury Park, N. J.

WANTED—A used communications rec. in good working condition, reasonably priced. William H. Paul, 8 Laurel St., Boston, Mass.

SWAP—Riders 1-5 Abr. 6-7-8-9-11-13; Gardiner code machine and tapes; new $45 mahogany table radio. Part or all for right communications rec. HQ129X preferred, SX25 or BC348 and others considered. Danely McCullough, 925 N. Main St., Paris, Ill.

WANTED—Zenith model No. 1000Z, chassis No. 2501, serial Nos. 174001 to 174100 also Nos. after 754106, 1935 production. Need not be in operating condition. Will buy or trade. Have a Webster 12 station master intercom unit in operating condition. Mark L. McClintock, 3429 N. Smedley St., Phila. 40, Pa.

FOR SALE—One postwar National communications rec., model NC-240-C, hardly used, with matched speaker, $185. Want modern console radio. H. Mansberg, 101 Cooper St., New York 34, N. Y.

SWAP—SW-3 for Instructograph with tapes. Metric Micrometers for Spintite Set. Compass Camera, worth $350., for Super-Pro, HQ-129. Pair EE-88 phones for portable typewriter. Auto radio less control cable and vibrator for whatever? Maj. Paul G. Moore, Hq, USAF, DCS/Materiel, AFMRD-4, Rm. 4D-138, Pentagon, Washington 25, D. C.

WANTED—Exchange technical data pertaining to 5" Panoramic Hallicrafters, model S35 manufactured in 1942. Will pay for the list of parts corresponding to the circuit diagram designation numbers. Will answer all letters. A. Laperriere, Vercheres, P.Q., Canada.

SALE OR TRADE—Silver Sparx sig. tracer, model 905, new, $35; Precision counter type tube tester, model 815, test all tubes to 50V fil., $40. Or will trade tube tester plus cash for Precision model EV10PM-VTVM. Sid's Radio, 49 Christie Ave., Clifton, N. J.

FOR SALE—Auto radio generator and ammeter condensers. Ten assorted, $1.50. Blank radio dash plates for '46, '47, '48 Dodge and Ford cars, 30c each. No COD. Andrea Radio, 107 Franklin Ave., Rochelle Park, N. J.

SWAP—Do you want things Chinese? We want Jan inspected tubes: 6SA7, 6SK7, 6V6GT, 5Y3GT, 12A6 etc., give prices and details to McChang, P.O. Box 341, Shanghai O, China.

FOR SALE—ICS radio service course, $75; Modern Radio Servicing by Ghirardi, $4; Audel's Radiomens Guide, $3; Also other books. Nicholas E. Basil, 611 - 1st Ave., Rock Falls, Ill.

FOR SALE—QST magazine, April 1934 to Aug. 1947. Make offer for all or part. H. Messerschmidt, 329 So. Maple, Oak Park, Illinois.

FOR SALE—Rider Manuals, 1 thru 14, also Rider's record changers and recorders, $150. Jackson Oscillator 640; Weston 722 Analyser; Feiler sig. tracer TS-2; Radiart P-6 vibrator tester; price $75. Julius R. Bartz, 1412 N. 26th St., Milwaukee 5, Wis.

FOR SALE—Radio store; Radios, Repairs, Appliances and Novelties. Completely equipped with large electrical street sign. Write for further details. Ryer Radio and Electric Co., 2269 Ryer Ave., Bronx 57, N. Y.

FOR SALE—RME-45 with matching speaker, perfect condition and in the original carton, $110. Harold S. Spohn., 319 N. Evans St., Pottstown, Pa.

WANTED—Surplus Kurman relays, having following data on label: DPDT 800 ohm 10V DC. Standard octal base. Cash or trade. Albert F. Toth, 38 Park Row, New York 7, N. Y.

TRADE—Sam's 1-13, individually in folders by manufacturers, for Riders No. 8 & 9 in good condition. Also for sale: McMurdo Silver 905, $35 and Brentwood 25W amplifier, $35. Joseph J. Dargo, 95 Ellison Ave., Roosevelt, L. I., N. Y.

SALE OR TRADE—Hammarlund HQ-120-X, type crystal, tuning range 31-.54mc, 10" PM dynam. speaker, 12 tubes, ear phone connection. Excellent condition, $100. Or trade for accordian, radio phono cabinet combination, or what have you? E. L. Kelly, Fairfield, N. C.

FOR SALE—Transvision 12" television rec., standard model, with cabinet, image definer, has additional A.F.C. in horizontal sync. circuit. Shipped complete ready to operate on receipt of money order or certified check for $320. Bernard Fox, 76 Murray Ave., Goshen, N. Y.

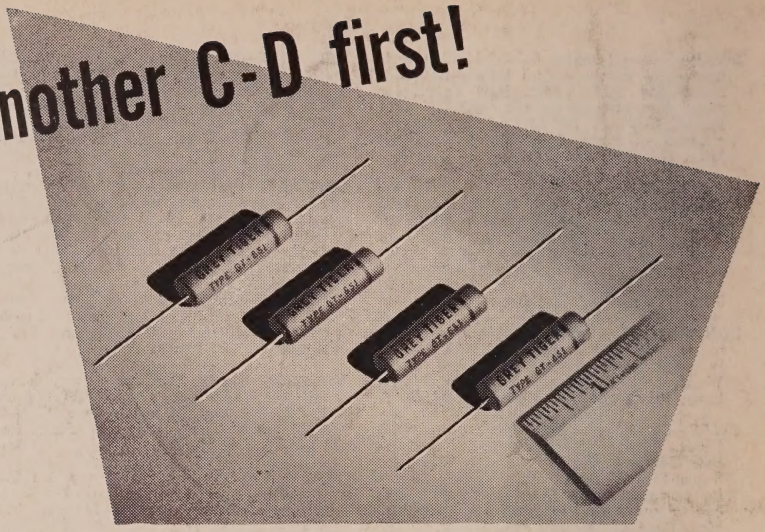
SELL—50 watt FM transmitter and rec. Both crystal controlled, range 30 to 40mc., designed for police and fire stations. Excellent condition. Voorhees Electronic Service, 35 Myrtle St., Ashland, Mass.

SALE OR SWAP—Astatic pick-up model H-P36; Detrola automatic record changer, model N200; Knight wireless phono oscillator. All good condition. Make offer. Glenn Troxel, Verona, Ill.

FOR SALE—BC-342N rec., with speaker and earphones to match. Set purchased in orig. factory carton and is in new condition, $65 FOB. W. A. Schroeder, M.D., 205 N. Main St., Anna, Ill.

FOR SALE—Back number records, such as by Louis Armstrong, King Oliver, Rhythm Kings and others. Tom Brown, 1220 Eighth St., New Orleans, La.

another C-D first!



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